Study on Left Atrial Dimension and Function After Modified Endoscopic Procedure for Atrial Fibrillation at Two Years' Follow-Up

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Background. **Modified endoscopic procedures for atrial fibrillation (AF) have a greater success rate because of the increased number of linear lesions. Concerns have been raised about the impact of ablation scars on the left atrium. This study aimed to examine the impact of ablation on left atrial dimension and systolic function after modified endoscopic procedures with echocardiographic measurement.**

Methods. **Of 107 patients undergoing modified endoscopic ablation, 58 had paroxysmal AF and 49 had persistent or long-standing AF. The procedure was performed on the beating heart through three ports on the left chest wall. Three circular and two linear lesions were made on the left atrium. The left atrial appendage was excised by stapler. Echocardiography was performed preoperatively and at the 2-year follow-up.**

Results. **Most patients (86.9%) patients were in sinus rhythm (SR) postoperatively. Fourteen patients (5 with paroxysmal AF and 9 with persistent/long-standing AF) failed to maintain SR. Echocardiographic data indicated that the left atrial diameter decreased only in the patients with postoperative SR but continued to increase in patients with fail SR maintenance. Left atrial function was also improved after the procedure, especially in patients with preoperative nonparoxysmal AF or with postoperative SR maintenance. Furthermore, left atrial function in patients who failed to restore SR was not worsened even with left atrial appendage excision.**

Conclusions. **Modified endoscopic procedure for AF improved post-procedural left atrial function of patients with SR maintenance. The left atrial function of patients with failed SR maintenance was also not worsened after left atrial appendage excision.**

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Atrial fibrillation (AF), the most common cardiac arrhythmia, reduces cardiac function and increases the incidence of stroke [1]. Ablation is an effective treatment of AF. Compared with antiarrhythmic drugs, catheter ablation has demonstrated better symptomatic relief and quality of life, but the success rate of single procedure needs improvement [2]. Increasingly, endoscopic ablation has attracted greater interest for its high quality of ablation lesions, which result in the guaranteed transmurality and integrity of lesions on the left atrium by bipolar clamp [3]. Modified procedures have increased the number of linear lesions to mimic the Maze procedure, which has led to increased rates of successful ablation [4]. Despite the increased success rate, concerns have been raised whether the impact of scars made by ablation may decrease left atrial (LA) function.

The evaluation of LA function has been discussed in detail. In general, the three distinct functional components that describe LA function are reservoir, conduit, and pump function. Reservoir refers to the left atrium undergoing passive expansion and refilling with blood from the pulmonary vein, which is driven by the apical descent of the mitral annulus in the period of ventricular systole and mitral valve closure. After the completion of ventricular ejection, the left atrium serves as a conduit to let blood flow directly from the pulmonary veins into the left ventricle. Reservoir and conduit can be considered as a passive function of the left atrium. Compared with its passive function, the pump function is characterized by the active contraction of the left atrium, which increases ventricular end-diastolic volume and is especially important for elderly patients and patients with impaired systolic function [5, 6]. This study aimed to examine the impact of ablation on the dimension and the systolic function of left atrium after modified endoscopic procedure as determined by echocardiographic measurement.

Patients and Methods

Patient Selection

Patients with AF underwent the procedure (n = 107) from October 2010 to March 2014. The study protocol

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Abbreviations and Acronyms

AF = atrial fibrillation
LAA = left atrial appendage
LAD = left atrial diameter
LAEF = left atrial emptying fraction
LAAEF = left atrial active emptying fraction
LAVmax = maximum left atrial volume
LAVmin = minimum left atrial volume
LAVP = left atrial volume immediately before atrial systole
LVEF = left ventricular ejection fraction
SR = sinus rhythm

was approved by the institutional review board, and informed consent was received from all patients. Patients were selected with the following inclusion criteria [7]: drug-refractory AF, failed catheter ablation, or history of stroke or embolism. All patients had left ventricular fraction of 30% or greater. Previous cardiac or lung surgical procedures and a left atrium larger than 70 mm were relative contraindications.

Endoscopic Ablation Procedure

All procedures were performed as previously described [4]. Three ports close to the subscapular angle line of the left chest wall were created. The ablation procedure included three circular and two linear lesions on the left atrium. Ablation of the two pulmonary veins was achieved by bipolar radiofrequency ablation with the AtriCure Isolator Synergy ablation clamp (AtriCure, Inc, West Chester, OH). The third circular lesion from the left inferior pulmonary vein to the right superior pulmonary vein was made by clamp. Linear lesions of the left atrium included the left pulmonary vein to incision of the LA appendage (LAA) and the left inferior pulmonary vein to the mitral valve annulus. LA appendectomy was performed with the EZ 45 stapler (Ethicon Endo-Surgery, Cincinnati, OH) or Endo GIATM (Covidien, Minneapolis, MN). The ablation of ganglionic plexus on the epicardium was also made by the AtriCure Isolator Synergy ablation pen (AtriCure, Inc). Subsequently, if sinus rhythm (SR) failed to be restored, cardioversion was performed immediately.

Postoperative Medical Management and Follow-Up

Postoperative anticoagulation with warfarin or aspirin was administered in accordance to CHA_2DS_2 or CHA_2DS_2-VASc, and HAS-BLED scores in the blanking period (3 months after the procedure). Anticoagulant drugs were discontinued if SR was present after the blanking period. Aspirin (100 mg/d) was continued if AF was recurrent. Amiodarone was administered to patients at 200 mg/d for 3 months after the procedures and was then tapered off in the presence of a stable SR. Electrical cardioversion was performed if a patient had symptomatic AF less than 48 hours or was adequately anticoagulated. Heart rhythm documentation was based on electrocardiograms and 24-hour Holter monitoring analysis. AF was deemed recurrent if an episode of AF (of duration >30 seconds, independently of amount of episodes or symptoms) occurred after the blanking period.

Echocardiographic Assessment

The echocardiographic results were collected from 1 week before the procedure and 2 years after the procedure. All images were obtained with a Philips iE33 ultrasound machine (Philips Medical Systems, Andover, MA). Two-dimensional, tissue-harmonic images were obtained in the parasternal plane (for LA diameter [LAD] measurement and apical two- and four-chamber views). The maximum (LAVmax) and the minimum (LAVmin) LA volume were calculated from these apical four- and two-chamber zoomed views of the left atrium with the use of the biplane method of discs with a frame rate of 80 frames/s. LA emptying fraction (LAEF) is calculated as follows: (LAVmax − LAVmin)/LAVmax. To evaluate LA mechanical function, LA volume (LAVP) was obtained immediately before atrial systole (before the electrocardiographic P wave in SR or just before mitral valve opening in AF). LA active emptying fraction (LAAEF) was derived as follows: (LAVP − LAVmin)/LAVP [8, 9]. Left ventricular ejection fraction (LVEF) was calculated by Simpson's method. The measurements were acquired from three consecutive beats and subsequently averaged. Measurements were performed by two observers who were blinded to the patients at the time of echocardiographic assessment.

Statistical Analysis

Qualitative variables were expressed as numbers and percentages, and quantitative variables were expressed as mean ± standard deviation. Continuous variables were compared with the one-way analysis of variance for unpaired variables or the paired Student's t test for paired variables. A p value less than 0.05 was considered statistically significant. Data were analyzed with Statistical Package for Social Systems, version 12.0, software for Windows (SPSS, Inc, Chicago, IL).

Results

Clinical Characteristics

A total of 107 patients were treated with the modified endoscopic ablation procedure for AF. The clinical characteristics of the patients are listed in Table 1. The procedure was successfully completed for all enlisted patients. Short-term procedural success rate was 100%. No conversion to sternotomy or thoracotomy was seen. No deaths occurred in this population. No patient required pacemaker insertion. No obvious complications occurred after the procedures. Ninety-nine patients (92.5%) maintained SR at the time of discharge. All follow-up durations were more than 24 months. The 107 patients had echocardiograms performed both at baseline and at 2 years. Ninety-three of 107 patients were free from AF, as confirmed on electrocardiograms or 24-hour Holter monitoring, and all were asymptomatic. Rate of 2-year